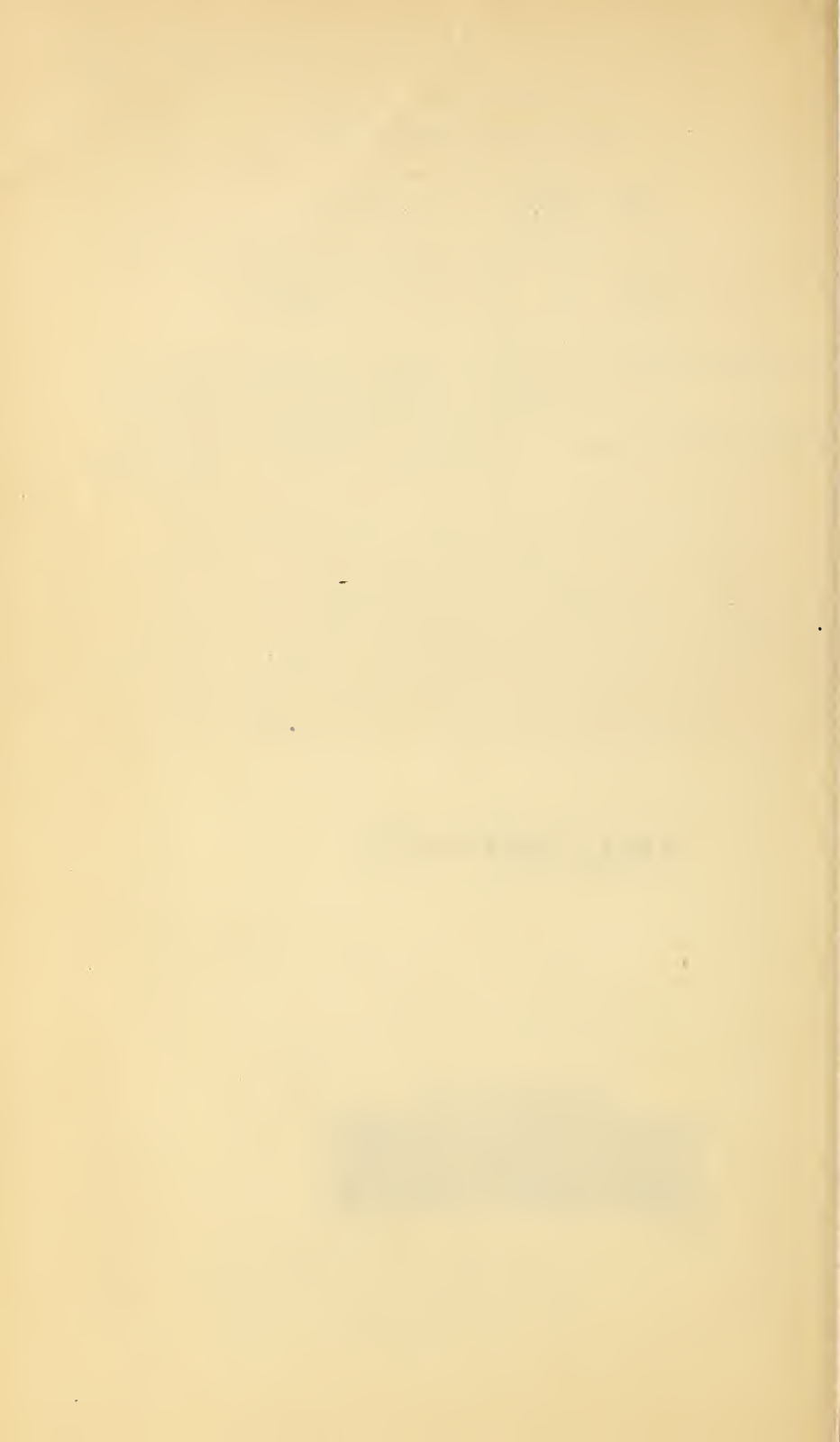


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## IMPROVED APPARATUS FOR USE IN MAKING ACIDITY DETERMINATIONS OF CORN.<sup>1</sup>

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### INTRODUCTION.

The method which is generally used for determining the degree of acidity of corn was described by Black and Alsberg, of the United States Department of Agriculture,<sup>2</sup> and also by Schindler,<sup>3</sup> and later by Besley and Baston.<sup>4</sup>

In Bulletin 102 of the United States Department of Agriculture will be found a detailed description of the method for determining the degree of acidity of corn, together with illustrations of the necessary apparatus and charts, tables, etc., showing the relation of corn acidity to the various commercial grades of corn that were in use prior to the promulgation of the Federal corn grades, which became effective July 1, 1914.

It is the purpose of the writers to supplement the information contained in the bulletin mentioned by bringing to the attention of other investigators and of the grain trade generally the advantage of using a mechanical mixer in determining the acidity of corn, by which the time for making the test can be reduced from 16 or 18 hours to less than 1 hour. This mixer, when running at a speed of not less than 7,500 revolutions per minute and operating under a load of 20 grams of corn meal and 100 cubic centimeters of alcohol, will cause to be extracted from the corn in 30 minutes an amount of acid-reacting substances comparable to the amount extracted through digestion in 80 per cent alcohol at room temperature for 18 hours. Thus, the time for making the determination can be reduced to such an extent as to make it applicable for commercial use.

<sup>1</sup> The investigations reported herein were made by the Office of Grain Standardization of the Bureau of Plant Industry. Since August 18, 1916, the grain-standardization work of the Department of Agriculture has been administered jointly by the Office of Markets and Rural Organization and the Bureau of Plant Industry in connection with the administration of the United States Grain Standards Act.

<sup>2</sup> Black, O. F., and Alsberg, C. L. The determination of the deterioration of maize, with incidental reference to pellagra. U. S. Dept. Agr., Bur. of Plant Indust. Bul. 199, 36 p. 1910.

<sup>3</sup> Schindler, Josef. Anleitung zur Beurteilung des Maises und seiner Mahlprodukte mit Rücksicht auf ihre Eignung als Nahrungsmittel, 43 p., 1 pl. Innsbruck, 1909.

<sup>4</sup> Besley, H. J., and Baston, G. H. Acidity as a factor in determining the degree of soundness of corn. U. S. Dept. of Agr. Bul. 102, 45 p., illus. 1914.

## DESCRIPTION OF MIXING APPARATUS.

Figure 1 shows a special battery of six electrical mixers used in the laboratories of the Office of Grain Standardization for making corn-acidity tests. By lowering the plunger into the upright tube, the contact is made and the motor started, which also automatically brings the agitator into the substance to be mixed, where it is held in place by a catch. Contact is broken and the motor stopped by releasing this catch and raising the plunger. The mixer on the left (fig. 1, *A*) is shown as it appears when in operation, the five mixers

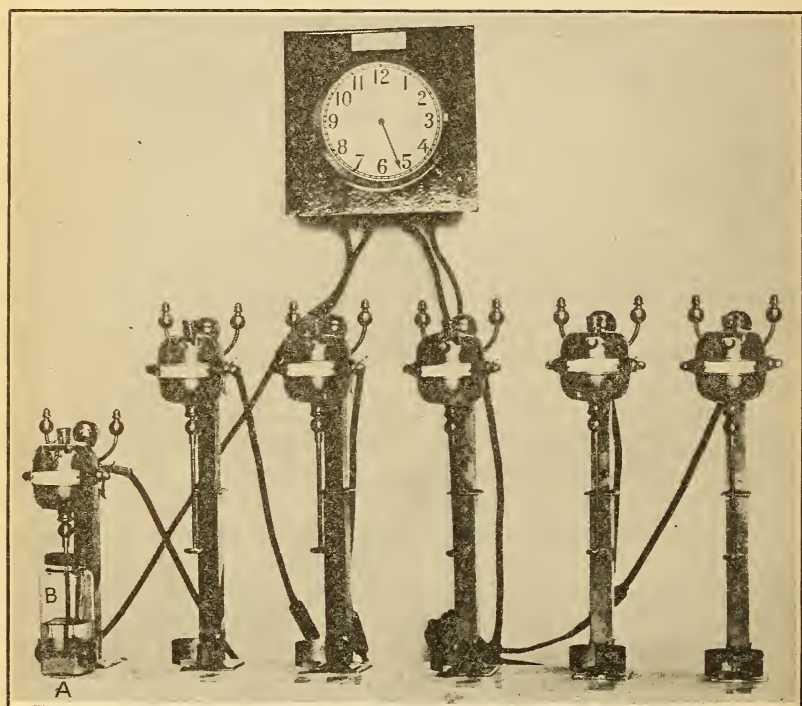


FIG. 1.—A special battery of six electric mixers.

on the right being shown with the plunger raised and the motor at rest. At the base of the upright tube will be seen a clasp to hold the container in place. The most satisfactory container that has been found in which to mix the ground corn and alcohol is shown in figure 1, *B*. This is a heavy glass bottle, about 2 inches square at the base and  $5\frac{1}{2}$  inches high, having a capacity of 8 ounces. This is a common stock bottle and can be secured from any firm dealing in laboratory apparatus.

Figure 1 also shows, suspended above the mixers, an automatic time switch. This switch is not a necessary part of the apparatus, but

where a great number of samples are handled it is an advantage, inasmuch as the method employed in making the test stipulates a continuous mixing for 30 minutes and this switch may be depended upon to cut off the current automatically and thus stop the mixers at the expiration of that time.

#### DESCRIPTION OF THE METHOD EMPLOYED IN TESTING CORN FOR ACIDITY WITH THE USE OF AN ELECTRIC MIXER.<sup>1</sup>

A representative sample (about 100 grams) of the corn to be tested should be ground into meal of such fineness that at least 80 per cent will pass through a sieve containing 20 meshes to the inch. Weigh accurately 20 grams of the meal and transfer to a heavy 8-ounce glass bottle about 2 by 2 inches at the base and  $5\frac{1}{2}$  inches in height. Add 100 cubic centimeters of 80 per cent alcohol with a specific gravity of 0.86 and subject at once the alcohol and meal to the continuous action of the electric mixing apparatus described herein for exactly 30 minutes.

After 30 minutes' mixing, transfer the contents of the bottle at once to dry filter papers and collect two 25 c. c. portions of the clear filtrate. Place each 25 c. c. portion in a 250 c. c. beaker, add 75 c. c. of distilled water, 1 c. c. of phenolphthalein solution (1 gram phenolphthalein in 300 c. c. of 80 per cent alcohol), and titrate with a one-hundredth normal alkali solution. Throughout these investigations potassium hydroxid has been used exclusively.

The result of the titration will represent the acidity of the 5 grams of corn plus the acidity of 25 c. c. of alcohol, 75 c. c. of distilled water, and 1 c. c. of phenolphthalein solution. Although the acidity of distilled water is practically negligible, the alcohol often carries quite a high degree of acidity, which fact must be taken into consideration in expressing the true acidity of the corn. In order to make correction for the acidity of the alcohol, water, and phenolphthalein, make a blank by taking 25 c. c. of alcohol, 75 c. c. of distilled water, 1 c. c. of phenolphthalein solution, and titrate in the same manner as in the titration of the alcoholic extract of the corn. Subtract the reading thus obtained from that obtained by the titration of the corn extract, and the result will represent the acidity of the 5 grams of corn. Multiply this result by 2 and the result will represent the number of cubic centimeters of a one-hundredth normal alkali solution required to neutralize the acid in 10 grams of corn, or the number of cubic centimeters of normal alkali required to neutralize the acid in 1,000 grams of corn. This result is termed the "degree of acidity of the corn."

<sup>1</sup> This is the method described in Department of Agriculture Bulletin No. 102, modified to meet the requirements of the electric mixer.



The most important feature of the test is the actual measurement of the acid in the alcoholic extract. This is accomplished by titrating it against a standard alkali solution. In order to obtain satisfactory and uniform results it is necessary to carry the titration to a definite color, which is perhaps a slight degree over the point of neutrality; but it is required in order to overcome the difficulty that one encounters when trying to titrate a solution in which has been precipitated alcohol-soluble proteids by the addition of water. A colored plate and a detailed description of the method for determining this end point can be found in Department of Agriculture Bulletin 102, which will aid analysts when making this titration to get results which will be comparable with the results obtained by other investigators. The end point referred to is the one which has been used with success by the investigators of corn acidity in the United States Department of Agriculture.

#### SUMMARY.

A detailed report of the investigations of corn acidity by the Office of Grain Standardization can be found in United States Department of Agriculture Bulletin 102. These investigations involved the handling of several thousand samples, all of which were analyzed by means of digestion in alcohol for a period of 16 to 18 hours.

In the attempt to reduce the length of time required to test corn for acidity, a mechanical electric mixer has been devised. The results obtained by the use of this mixer check satisfactorily with those obtained by extraction in 80 per cent alcohol at room temperature for 18 hours, which method is the one used by previous investigators.

While there is some variation in the results of acidity determinations obtained by different methods, it may be said that the electric mixer will cause to be extracted from the corn in 30 minutes an amount of acid comparable for all practical purposes to the amount extracted in 80 per cent alcohol at room temperature through 18 hours of digestion.



